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A Revision of the North American Species of the Genus *Eleutera*
Beauv. (*Neckera* Hedw.)

BY STEPHEN CONRAD STUNTZ

This work on the genus *Eleutera* was begun at the suggestion of Dr. C. R. Barnes, now of the University of Chicago, carried on in the Herbarium of the University of Wisconsin, and completed under the direction of Dr. R. H. True.

Thanks are due to the authorities of the following herbaria for loans of material in this genus—Herbarium of the Canadian Geological Survey, Herbarium of Columbia University, and the National Herbarium; to Dr. Julius Röhl and M. Jules Cardot for specimens unobtainable in this country; to Dr. R. A. Harper for assistance in obtaining material; to Mrs. E. G. Britton and Dr. E. L. Greene for assistance in bibliographical details; to Dr. Barnes for helpful comment and criticism; and to Dr. True for general aid and advice.

There is a tendency among bryologists to begin with Hedwig, *Muscorum Frondosorum*, 1792, for purposes of nomenclature, but it has seemed best to adhere strictly to the rules adopted by the Madison Botanical Congress. Changes necessitated by the adoption of Hedwig as a starting point are noted.

ELEUTERA Beauv. Prodr. 30. 1805

(NECKERIA Hedw. Fund. Musc. 2: 93. 1782. Not Scopoli, Introd. 313. 1777.

NECKERIA Hedw. Musc. Frond. 3: 52. 1792.

ELEUTERIA Beauv. Prodr. 56. 1805.

CRYPTOPODIA Röhl. Deutsch. Fl. 3: 82. 1813.

NECKERIA DISTICHIA Brid. Bryol. Univ. 2: 238. 1827.

EUNECKERIA C. M. Syn. 2: 41. 1850.

DISTICHIA C. M. Flora, 73: 489. 1890.)

Gametophyte large, spreading, on trunks of trees and rocks: primary stems short, creeping, often stoloniferous: secondary stems erect or pendent, pinnately or bi-pinnately branched: branches complanate, sometimes flagelliform: leaves complanate,

usually transversely undulate, glossy : outer perichaetial leaves ovate, inner long-acuminate : cells rhomboidal at apex, becoming oblong at middle, and linear-oblong or sinuous at base, smooth : alar cells rounded-quadrate. *Sporophyte* : capsule immersed or exserted, symmetrical : calyptra cucullate : peristome double : teeth 16, lance-linear, closely articulate, thin : endostome a short basal membrane, 16-cleft, without cilia : annulus none. (From Greek *Eleuthera*, epithet applied to Diana.)

The genus includes 158 species, according to Paris, Index Bryologicus, distributed throughout the temperate zones and tropics.

The generic name, *Neckera* of Hedwig, afterwards written *Neckera*, given in honor of N. J. Necker, the German bryologist, was antedated by *Neckera* Scopoli, given to what is now known as *Corydalis* or *Capnoides*. In 1805 Palisot de Beauvois, in his *Prodrome des cinquième et sixième familles de l'Aethérogamie*, divides Hedwig's and Bridel's *Neckera* into *Neckera* and *Pilotrichum*, (generic characterizations and lists of included species on pp. 35 and 37), and, on p. 30 he gives "*Eleutera*" as a substitute for *Neckera*, which he would abolish because of its being given in honor of a man ; on p. 56, in the "Table des Mousses," he gives "*Eleuteria*. *Eleuterie* (common name). Nom que je propose de donner au genre Neckera." This, in connection with the lists of species on pp. 35 and 77-8 amounts to generic publication, although no binomials were published. In his generic characterizations, and also under *Neckera* in "Table des Mousses," he gives "*Eleutrie*" as the common name which he proposes for the genus.

The genus *Eleutera* differs from the nearest North American genus, *Homalia*, in having narrow, not distinctly keeled segments, and no annulus.

The total number of North American species of the genus is six. Two of the species are sub-tropical ; one of these is limited to Florida ; the other occurs in Florida, Texas and New Mexico. Two species are northwestern, occurring from Alaska to northern Idaho and central California. One is limited to the Alleghanies. The remaining species, or one of its two varieties, is distributed from Newfoundland to Lake Athabasca and the Rocky Mountains, south to North Carolina, and in New Mexico (Fendler). All the species except the sub-tropical ones, which are found only on trees, grow on both trees and rocks.

No North American specimens of *E. fontinaloides* (*N. pumila*) have been seen, and it is likely that Bruch and Schimper were wrong in crediting it to North America. *N. Ludoviciae* and *N. cymbifolia* are referable to *Pilotrichum*, as is probably *N. Floridana* also, although all the specimens examined bearing this name in herbaria are really *E. disticha*.

Synopsis of the Species

Leaves acute or acuminate.

Spinulose.

1. *E. Douglasii*.

Not spinulose.

2. *E. pennata*.

Leaves rounded or lingulate, apiculate or abruptly acuminate.

Leaves undulate.

Costa $\frac{1}{3}$ length of leaf or less.

Delicate, branched.

2a. *E. pennata oligocarpa*.

Robust, simple.

2b. *E. pennata pterantha*.

Costa $\frac{2}{3}$ length of leaf.

Long, loose, flagellate.

3. *E. Menziesii*.

Short, soft, no flagella.

3a. *E. Menziesii limnobioides*.

Leaves plane.

4. *E. ornithopodioides*.

Leaves obtuse.

Base of leaves unsymmetrical, costa far to one side.

5. *E. disticha*.

Base of leaves symmetrical.

6. *E. Jamaicensis*.

1. *Eleutera Douglasii* (Hooker) nom. nov.

Gametophyte loosely spreading or pendent, pale or yellowish-green: primary stems 3–4 cm. long: secondary stems 10–20 cm., pinnately branched: branches long, attenuate to apex: leaves lanceolate-acuminate, spinulose at apex, wavy at base, thin, glossy, ecostate: dioicous: outer perichaetial leaves ovate, acute, denticulate at apex, inner leaves lanceolate, acute, reaching to base of capsule or rarely higher. *Sporophyte*: capsule oval, reddish-brown, becoming chestnut, entirely exserted: lid long-rostrate, oblique: teeth yellow, articulate: segments equaling teeth, the latter not divided between articulations. (In honor of David Douglas (1798–1834), an early northwestern collector, who collected the species on the Columbia River.)

Type locality, Columbia River.

Trees and shaded rocks, Alaska, Vancouver Island and Coast Range, B. C., east to Lake Pend d'Oreille, Idaho, south to San Mateo Co., California.

Syn.: *Neckera Douglasii* Hooker, Bot. Misc. 1: 131. pl. 35. 1830. *Neckera Douglasii Macounii* Kdbg. Bull. Torr. Club, 17: 275. 1890.

Illus.: Hooker, l. c.

Exsic.: Sull. & Lesq. *Musc. Bor. Am.* (Ed. 2) 394; Macoun, *Can. Musc.* 88, 104, 200, 241, 389 (var. *Macounii*); Ren. & Card. *Musc. Am. Sept. Exsic.* 77, 77*b*; Röhl, 410, 411.

The Kindbergian variety, *Macounii*, described as having a turgid-oval capsule exserted on long pedicel and leaves less attenuate, cannot stand, as none of the specimens so labeled in the herbaria examined agree with the printed description or differ materially from Hooker's original description. Lesquereux and James' description of the species is incorrect in several minor details.

2. *Eleutera pennata* (L.) nom. nov.

Gametophyte bright green, glossy, large, spreading: primary stems short: secondary stems 7–10 cm., irregularly pinnate, sometimes simple: branches usually obtuse, sometimes attenuate: leaves narrowly ovate-lanceolate, acuminate, entire or sometimes denticulate above: costa indistinct, bifid or single: cells small, thin, at apex elongated-rhomboidal, at middle and base linear, sinuous, at angles irregularly quadrate: monoicous: outer perichaetial leaves short, ovate-acuminate, inner long-acuminate, entire, exceeding the capsule. *Sporophyte*: capsule, large, oval-oblong, reddish-brown, immersed: calyptra small, whitish, covering lid only: lid conical, short-beaked: teeth linear-subulate, connected at tips, densely articulate, irregularly divided: segments imperfect. (From Latin *pennata*, furnished with wings.)

Type, European.

On trees and rocks. Newfoundland and Nova Scotia, south in mountains to North Carolina, west to Manitoba; Mexico (Bescherelle).

Syn.: *Muscus terrestris major, ramulis compressis, foliis superficie crispis* Vaill. Bot. Par. 129. pl. 27. f. 4. 1727. *Sphagnum pennatum undulatum, vagina squamosa* Dill. Hist. Musc. 250. pl. 32. f. 9. 1741. *Sphagnum cauliferum et ramosum, foliis crispis, crebris per caulem capitulis* Hall. Enum. Stirp. Helv. 96. pl. 3. f. 2. 1742. *Fontinalis pennata* L. Sp. Pl. 1371. 1763. *Hypnum pennatum* Hall. Stirp. Helv. 1297. pl. 45. f. 2. 1768. *Weisia pennata* Schrank, Bayer. Fl. 2: 445. 1789. *Neckera pennata* Hedw. Musc. Frond. 3: 47. pl. 19. 1792. *Filotrichum pennatum* Beauv. Prodr. 83. 1805. *Cryptopodia pennata* Röhl. Deutsch. Fl. 3: 82.

1813. *Daltonia pennata* W. Arn. Disp. 54. 1825. *Neckera Distichia pennata* Brid. Bryol. Univ. 2: 238. 1827.

Illus.: Vaill. l. c.; Dill. l. c.; Hall. l. c.; Hedw. l. c.; Funck, Deutsch. Moose, *pl.* 34. *f.* 1; Schmied. Icon. Pl. Man. 3: *pl.* 58. *f.* 2; Grev. Scot. Crypt. Fl. *pl.* 109; Hooker & Taylor, Musc. Brit. Supp. *pl.* 4; Bruch & Schimp. Bryol. Eur. *pl.* 440; Wilson, Bryol. Brit. *pl.* 34. *f.*; Sull. Musc. & Hep. U. S. *pl.* 5; Lesq. & James, Manual, *pl.* 5.

Exsic.: Drummond, Musc. Bor. Am. 161; Sull. Musc. Allegh. 76; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 266, (Ed. 2) 392; Aust. Musci App. 255; Ren. & Card. Musc. Am. Sept. Exsic. 188; Macoun, Can. Musci, 80, 239, 345, 584, 654, 666, 794. In Herbarium University of Wisconsin, Sull. & Lesq. 266 and 392 of the different editions are the same, the number 392 being pasted over the number 266 on the original packet.

2a. *Eleutera pennata oligocarpa* (Bruch) nom. nov.

Gametophyte small, delicate, pale green: primary stems short: secondary stems 2–5 cm., slender, irregularly pinnate: branches attenuate to apex, sometimes flagelliform: paraphyllia none: leaves lingulate, abruptly acuminate, deeply undulate, subserrate at apex: costa short or indistinct: cells rhomboidal at apex, at base and middle linear, at edges quadrate or rounded: outer perichaetial leaves ovate-acuminate, inner narrow-acuminate, ecostate, exceeding the capsule. *Sporophyte*: capsule small, reddish-yellow: calyptra large: lid orange, short-beaked: teeth lance-linear, densely articulate: segments imperfect. (From Greek *oligos*, few, and *karpós*, fruit.)

Type, European.

Trees and rocks. Prince Edward Island, west to Lake Athabasca and the Rocky Mountains in British America, south to the Catskills; Santa Fé, New Mexico (Fendler).

Syn.: *Neckera pumila* Wahlenb. Fl. Lapp. 367. n. 653. 1812; not *N. pumila* Hedw. *Neckera oligocarpa* Bruch, Mscr. in Hartm. Skand. Fl. 338. 1849. (5th ed.) *Neckera pennata* ♂ *tenera* C. M. Syn. 2: 50. 1850. *Neckera intermedia* Theden. in sched. *Neckera chlorocaulis* Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 268.

Illus.: Bruch & Schimp. Bryol. Eur. *pl.* 441.

Exsic.: Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 268 (as *N. chloro-*

caulis), (Ed. 2) 393; Aust. Musc. App. Supp. I., 528; Macoun, Can. Musci, 240, 797, 892.

2b. ***Eleutera pennata pterantha*** (C. M. & Kindb.) nom. nov.

Gametophyte: secondary stems nearly simple, about 1 dm. in length, rigid and robust, erect: one branch of costa often reaching to the middle of leaf: paraphyllia numerous. *Sporophyte*: capsule emergent. (From Greek *pteros*, wing, and *anthos*, flower.)

Type locality, rocks, Hector, B. C., the only locality from which it has been collected.

Syn.: *Neckera oligocarpa* var. *pterantha* Kdbg. in Herb. Can. Geol. Survey.

Neckera pterantha C. M. & Kindb. in Macoun, Cat. Can. Pl. Musci, 162. 1892.

Exsic.: Macoun, Can. Musci, 105, 494.

In case we begin with Hedwig, 1792, for nomenclature, the initial "L." in the species should be replaced by "Hedw."

On the original label in Herb. Can. Geol. Survey in what I take to be Kindberg's writing, the name of the variety is given as *pterantha*; for this reason that name is adopted instead of *peterantha*, which is evidently a slip, and quite meaningless.

All gradations occur between the species and what has been known as *N. oligocarpa*, so that we must recognize that as a mere variety. These slight and varying differences were recognized by C. F. Austin, who, on a label in the Columbia University Herbarium, says: "I am unable to find a single distinct *permanent* character for distinguishing between *oligocarpa* and *pennata*." Some of these gradations are: Coarse plants with very narrow leaves and attenuate branches; very robust plants with lingulate leaves; delicate plants with obtuse branches and narrow leaves.

Eastern American specimens of the var. *oligocarpa* agree with European specimens in having no paraphyllia, but specimens from Vermilion Lake, Minn., west to the Rocky Mountains have a few paraphyllia, tending toward var. *pterantha*.

3. ***Eleutera Menziesii*** (Drumm.) nom. nov.

Gametophyte large, yellowish-green, brown when old: primary stems 8–10 cm.: secondary stems 5–25 cm. in length, flat, densely pinnately branched: branches 1–10 cm., becoming flagellate at

apex, often covered with lateral filiform flagella, forming a dense brush: leaves oblong, lingulate, apiculate or sometimes obtuse, undulate: more or less regularly denticulate half way to base: costa $\frac{1}{2}$ – $\frac{2}{3}$ length of leaf: cells at apex irregularly rhomboidal, at middle and base narrow-oblong: dioicous: perichaetial leaves small, long-acuminate, denticulate, costate to apex: cells linear. *Sporophyte*: capsule reddish-brown, immersed or emergent, seta length of capsule: calyptra with few hairs or none: lid oblique, acute: teeth slender, nodose, articulate: segments very slender, split between the few articulations. (In honor of Archibald Menzies (1754–1842), who collected the species in the Rocky Mountains.)

Type locality, Rocky Mountains.

On trees and rocks. Alaska and Vancouver Island to Banff and Flathead Lake, Montana, south to Yosemite and Russian Valleys and Marion Co., California.

Syn.: *Neckera Menziesii* Drummond, Musc. Bor. Am. 162. *Neckera Menziesii* Hook. in Drumm. Musc. Bor. Am. (Ed. 1) 162 (according to Paris, Ind. Bryol. 853). *Neckera Menziesii amblyclada* Kindb. in Macoun, Cat. Can. Pl. Musci, 162. 1892.

Illus.: Sull. Icon. Musc. Suppl. *pl.* 62.

Exsic.: Drumm. Musc. Bor. Am. 162 type; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 395; Macoun, Can. Musci, 106, 111, 169, 198, 238, 397, 796, 567 (var. *amblyclada*), 253, 927 (var. *eflagellata*), 94 (approaching var. *limnobioides*); Röhl, 496, 497.

3a. *Eleutera Menziesii limnobioides* (Ren. & Card.)

nom. nov.

Gametophyte small, cespitose, soft and dilated, brownish-green: secondary stems but 1–2 cm. in length: habit of a *Limnobium*; no flagella. (From *Limnobium*, and *oides*, like.)

Type locality, Mt. Hood, Oregon.

Rocks, Cascades, Easton, Washington; Mt. Hood, Oregon.

Syn.: *Neckera Menziesii limnobioides* Ren. & Card. Bot. Cent. 44: 422. 1890.

There is no material difference between the so-called variety *amblyclada* and the species, the leaves on the same plant varying in length and in length of costa. As to flagella, all the specimens seen have more or fewer flagella.

Paris in Index Bryologicus 853, gives Hooker as the author of

the species, but Drummond's original label in Herbarium Can. Geol. Survey gives description, and Hooker himself, Bot. Misc. 1: 132, speaks of it as described by Drummond.

4. **Eleutera ornithopodioides** (Scop.) nom. nov.

Gametophyte small, soft, yellowish-green: secondary stems slender, 2–4 cm. in length, pendent, pinnately divided into short tapering branches, which are sometimes flagellate: leaves plane, unsymmetrical at base, elliptical, sharply and strongly apiculate, minutely serrulate at tip: costa short, indistinct: cells at tip rhomboidal, at middle and base linear, at angles very short and irregular: dioicous: perichaetial leaves narrow, long. *Sporophyte*: capsule small on long slender seta: lid narrowly oblique, rostrate, teeth pale, narrow: segments short from an enlarged base. (From *ornithos*, bird, *pous*, foot, *oidos*, like.)

Type, European.

Rocks, Newfoundland, south in mountains to Tennessee; rare.

Syn.: *Muscus trichomanoides filicifolius splendens* Vaill. Bot. Par. 139. *pl.* 23. *f.* 4. 1727. *Hypnum pennatum, compressum et splendens, capsulis ovatis* Dill. Hist. Musc. 268. *pl.* 34. *f.* 7. 1741. *Hypnum ornithopodioides* Scop. Fl. Carn. 164 1760. *Hypnum complanatum* L. Sp. Pl. 1588. 1763. *Leskia complanatum* Hedw. Fund. Musc. 2: 93. *pl.* 10. *f.* 62–65. 1782. *Leskea Omalia complanata* Brid. Bryol. Univ. 2: 327. 1827. *Neckera complanata* Hüb. Muscol. Germ. 576. 1832. *Homalia complanata* de Not. Epil. 199. 1869.

Illus.: Vaill. l. c.; Dill. l. c.; Hedw. l. c.; Smith & Sowerby, Eng. Bot. *pl.* 1492; Funck, Deutsch Moose, *pl.* 35. *f.* 1; Bruch & Schimper, Bryol. Eur. *pl.* 444; Wilson, Bryol. Brit. *pl.* 24b.

Exsic.: Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 267, (Ed. 2) 396.

All the American specimens seen are sterile; sporophyte description taken from European specimens.

In case Hedwig, 1792, is taken as starting point for nomenclature, replace "*ornithopodioides* (Scop.)" by "*complanata* (Hedw.)."

5. **Eleutera disticha** (Sw.) nom. nov.

Gametophyte small, soft, pale green: primary stems short: secondary stems 1–3 cm. in length, narrow, irregularly pinnate:

branches short: leaves broadly lingulate, rounded at apex, somewhat undulate, unsymmetrical, costa far to one side: tip somewhat wavy, minutely serrulate: costa slender, $\frac{3}{4}$ length of leaf: cells irregularly massed at tip, oblong at middle, narrowed at base: synoicous: outer perichaetial leaves ovate-acuminate, apical cells roughly triangular, basal and middle sinuous: inner perichaetial leaves narrow-acuminate, equaling or exceeding the capsule serrulate at apex, with narrow, sinuous cells. *Sporophyte*: capsule, immersed, or sub-emergent, urn-shaped: calyptra small, smooth; lid conical-acute, oblique: teeth pale, narrow lance-subulate, minutely wrinkled: segments equaling teeth, not keeled. (From Greek *distichos*, two-rowed.)

Type, West Indian.

Trees, coasts of Florida and throughout tropical America.

Syn.: *Fontinalis disticha* Sw. Pr. Fl. Ind. Occ. 138. 1788.

Neckera disticha Hedw. Musc. Frond. 3: 53. pl. 22. 1792.

Pilotrichum distichum Beauv. Prodr. 83. 1805. *Pilotrichum*

truncatum Beauv. Prodr. 83. 1805. *Daltonia disticha* W. Arn.

Disp. 54. 1825. *Neckera Distichia retusa* Brid. Bryol. Univ. 2:

243. 1847.

Illus.: Hedw. l. c.

Exsic.: Aust. Musc. App. Supp. I., 530.

This species is easily distinguished from the nearest North American species, *E. Jamaicensis*, by its smaller, very unsymmetrical leaves, as well as by its more slender stems and smooth calyptra.

Replace the "(Sw.)" by "(Hedw.)" if Hedwig be taken as the starting-point for nomenclature.

6. *Eleutera Jamaicensis* (Gmel.) nom. nov.

Gametophyte soft, yellowish-green: primary stems short: secondary stems short, 1–2 cm. in length, usually simple: leaves distichous, auriculate-clasping on the one side, nearly symmetrical, oblong-lingulate, truncate, transversely undulate, very minutely serrulate: costa slender, $\frac{4}{5}$ length of leaf: cells at tip small and irregularly massed, in middle oblong, at base narrow: synoicous: outer perichaetial leaves ovate, abruptly acuminate, inner narrow, linear, ecostate or short-costate, sub-serrulate, equaling the capsule. *Sporophyte*: capsule small, sessile, cylindrical-oblong, immersed: calyptra small, covering lid only, with few hairs; lid conical, oblique, short-beaked: teeth and segments free to base, nodulose, punctulate. (From Latin, *of Jamaica*.)

On trees, western and southern Florida, Texas (Wright). New Mexico, and throughout tropical America.

Syn.: *Sphagnum pennatum undulatum*, *vagina pilosa* Dill, Hist. Musc. 294. *pl.* 32. *f.* 8. 1741. *Hypnum Jamaicensis* Gmel. L. Syst. Nat. 1341. 1791. *Neckera undulata* Hedw. Musc. Frond. 3: 51. *pl.* 21. 1792. *Fontinalis crispa* Sw. Prodr. Fl. Ind. Occ. 138. 1788. *Pilotrichum undulatum* Beauv. Prodr. 83. 1805. *Daltonia undulata* W. Arn. Disp. 54. 1825. *Neckera Distichia undulata* Brid. Bryol. Univ. 2: 241. 1827. *Neckeropsis undulata* Reichardt in Novara Exp. Bot. 1: 181. 1871.

Illus.: Dill. l. c.; Hedwig l. c.; Bridel, Musc. Recent. 2: *pl.* 3. *f.* 21.

Exsic.: Aust. Musc. App. Supp. I., 529.

Replace "*Jamaicensis* (Gmel.)" by "*undulata* (Hedw.)" if Hedwig, 1792, is taken as a starting-point.

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